THE ECONOMIC LOSS IN THAI FISHERIES

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ABSTRACT

Main fishing gear in Thailand was otter board trawls. More than 70% of the total Thai fishing vessels had been using this fishing gear, as well as push net which was restricted targeting for demersal resources. Due to the 2.5 cm fine mesh size, juvenile economic species had been caught and sold as trash fish. Another important fishing gear which had conflict in utilization of fishery resources in Thailand was anchovy fishery, also using fine mesh size incurring by catches of juvenile economic species sold as trash fish. Von Bertalanffy growth function and length-weight relationship were employed in estimating the economic losses of these by catches of juvenile economic species. The loss of these economic species was estimated to be 10.82% of the usual fishing cost in case of anchovy purse seiner while it could be as high as 25.55% in case of light luring anchovy purse seine. For otter board trawler, this loss was estimated as high as 90.42% of the fishing cost, while they were 19.64% and 816.84% in case of push netters.

Keywords: otter board trawl, push net, anchovy purse seine, economic loss, Thai fisheries

INTRODUCTION

In spite of being one of the leading exporter for fishery products, Thai fishing grounds had been degraded due over-fishing not too long after the rapid development in otter board trawl in 1960s. Catch per unit effort decreased by over ten times from 298 kg/hr to less than 20 kg/hr recently. Due to the abundance in coastal resources, mainly demersal species and crustaceans, push netters increased. These are non-selective and destructive fishing gears using fine 2.5 cm mesh size catching juvenile economic species sold as low price trash fish. After degrading coastal fisheries resources, anchovy purse seine had been developed. Nevertheless these fishing gears used fine mesh size to catch anchovy, thus caught also juvenile economic species sold as trash fish.

This paper reviewed the economic loss in Thai fisheries. First, from the loss from fisheries in the Gulf of Thailand which covered more than three fourth of the total catches. Second, from the opportunity forgone for those juvenile economic species caught and sold as trash fish by push net, otter board trawl, and anchovy purse seine in the Gulf of Thailand.

THE ECONOMIC LOSS FROM THAI FISHERIES IN THE GULF OF THAILAND

Panayotou and Jetanavanich estimated bio-economic model using variable fish price. They converted the total fishing hours by various gears to be standard fishing hours and converted the total catches of various species to be standard catches so that the single species backward bending supply curve for fine 2.5 cm mesh size fishing could be estimated. Demand function representing the average revenue was also estimated as a exponential function. The result of estimation was given below. [1]

$$Y = 122.4E - 3.914E^2 \quad \text{..... (1)}$$

$$AR = 372.7Y^{-0.558} \quad \text{.....(2)}$$

Y = catch (ton)

E = standardized fishing effort (million hour)

AR = average catch revenue, price of the catch (Baht/ton)

From the estimated equations, maximum economic yield (MEY) at LRMC = AR was estimated, thus the fishing effort, total revenue, total cost, profit, consumer surplus, and total benefit (including resource rent and consumer surplus). The fishing effort at MEY was estimated to be 11.8 million standard fishing hours with the catch of 900 thousand ton. The total benefit including profits or resource rent and the consumer surplus was 14,173 million baht. The actual fishing effort was 62.71% greater than the MEY level, while the catch was 11.11% greater than the optimum effort at MEY. The actual cost was 62.73% higher than the cost at MEY while the revenue was 17.67% lower, thus a lower resource rent by 67.43% Due to greater catch the actual consumer surplus was 4.77% higher than the consumer surplus at MEY. Nevertheless the total actual benefit was 18.92% lower than the benefit at MEY. The lower benefit in this estimated year reflected forgone benefit or the economic loss of 2,682 million baht. Perpetually at the 5% discount rate assuming the same loss throughout, this loss would be 53,640 million baht.

At open access, without any effective management, the fishing effort was more than double that of MEY (118.64% greater), while catch would be 33.33% lower. Revenue was 16.41% lower while the cost was 118.65% higher while resource rent would be depleted. Consumer surplus was 16.40% lower due to less catch. In case of open access, without effective management, the loss would be 6,213 million baht a year or perpetually a total of 124,260 million baht. (Table 1)

Table 1: Economic loss of Thai fisheries in the Gulf of Thailand

Item	Effort	Catch	Revenue	Cost	Resource rent	Consumer surplus	Total benefit
	(mill.std.hr.)	(ton)	(mill.฿)	(mill.฿)	(mill.฿)	(mill.฿)	(mill.฿)
Maximum economic yield (MEY)	11.8	900	7,531	2,879	4,651	9,522	14,173
% change as compare to MEY							
Actual	62.71	11.11	-17.67	62.73	-67.43	4.77	-18.92
Open access	118.64	-33.33	-16.41	118.65	-100.00	-16.40	-43.84

Source: Calculated from Panayotou and Jetanavanich (1987).

THE ECONOMIC LOSS FROM BY CATCHES OF JUVENILE ECONOMIC SPECIES

Three main fishing gears in the Gulf of Thailand i.e. otter board trawl, push net, and anchovy purse seine using fine mesh size catching juvenile economic species as by catches and sold them as trash fish at low price. In this section von Bertalanffy growth function and Sparre length-weight relation were employed to estimate the opportunity cost in term of forgone value of marketable of those by catches in case that they could grow to marketable size before being caught by Thai fishing vessels.

The estimation

From each fishing vessel catches of juvenile economic species were collected. The length and the catch weight of the each juvenile economic species were recorded. From the length, the weight of one fish could be calculated by Sparre length-weight relationship.

$$W_{t_n} = aL_{t_n}^{\ b} \quad \text{.....(3)}$$

W_{t_n} = weight of one juvenile fish (gm/fish)

L_{t_n} = length of one juvenile fish (cm.)

a, *b* = biological parameters for each juvenile economic species

Then from the record on weight of that by catch juvenile species, N_{t_n} the number of juvenile fish could be calculated by dividing the weight by W_{t_n} as estimated from (3). From this number the number of survival fish at marketable size could be estimated from the following.

$$N_{t_p} = N_{t_n} e^{-z\Delta t} \quad \text{.....(4)}$$

N_{t_p} = number of survived fish

Z = mortality rate

Δt = time length from the time being caught as juvenile until growing to marketable size

This Δt could be calculated from von Bertalanffy growth function.

$$L_{t_p} = L_\infty (1 - e^{-k\Delta t}) \quad \text{.....(5)}$$

L_{t_p} = marketable size length of the economic species

L_∞ = the length at infinity

k, L_∞ = biological parameters.

Then calculate the weight of each marketable size economic fish.

$$W_{t_p} = aL_{t_p}^{\ b} \quad \text{..... (6)}$$

Find the forgone value by multiplying the weight, number, and marketable price, *p*.

$$\text{Loss} = N_{t_p} * W_{t_p} * p \quad \text{..... (7)}$$

The estimation had been done for small otter board trawler (< 14 m long) and push netter in the upper Gulf of Thailand, push netter in the lower Gulf of Thailand, anchovy purse seiner, and anchovy light luring purse seiner in the eastern Gulf of Thailand.

The Results

In term of catch weight, 78.53% of total catch of push netter in the upper Gulf was juvenile economic species which if had been left to grow to marketable size could be caught at the value of more than 8 times higher than the total cost of this push net fishing. This could be explained by the demersal resource abundance in the earlier 1990s. Push net in the upper Gulf was non-selective gears and had a severe impact on coastal fishery resource abundance.

Second highest in term of economic loss as percentage of total fishing cost was the small otter board trawler in the upper Gulf. The economic loss was estimated to be 90.42% of the fishing cost. Accounting for these forgone, push net and small otter board trawl in the upper Gulf in early 1990s, in spite of the fishing profits of 20.67% and 3.89% of fishing cost, could not be profitable fishing gears.

Push net in the lower Gulf in late 1990s caught less percent of juvenile economic species compared to the upper Gulf. Due to less resource abundance the rate of profit was lower. Economic loss from forgone was 19.64%.

For anchovy purse seiner in mid 1990s the profit was 45.87% of total fishing cost. Nevertheless this had accounted for net revenue from processing on board, not just the fresh catches. The economic loss from juvenile by catches was 10.82%. This was the only fishing gear that was still profitable after deducting the forgone cost. Anchovy light luring purse seiner caught more juvenile economic species, 39.36% of total catch. While the fishing profit was only 2.34%, the economic loss from forgone value of economic species was 25.55% of total cost.

Three of the selecting fishing gears could not be profitable accounting for economic loss of forgone economic species caught as by catches and sold as trash fish. (Table 2)

Table 2: Economic loss from by catches of economic juvenile species by selected type of fishing vessels

Item	Fishing ground	Juvenile economic species by catches as % total catch weight	Fishing profit as % of total fishing cost	Economic loss as % of total fishing cost
Small otter board trawler*1	Upper Gulf	1.53	3.89	90.42
Push netter*1	Upper Gulf	78.53	20.67	816.84
Push netter*2	Lower Gulf	15.25	0.32	19.64
Anchovy purse seiner*3	Eastern Gulf	1.92	45.87	10.82
Anchovy light luring*3	Eastern Gulf	39.36	2.34	25.55

Source: Calculated from *1 Suteemeechaikul (1992) *2 Dechboon (1998) and *3 Saikliang (1995).

In Table 3 the percentages of juvenile economic species caught as trash fish were given, so did the percentages of economic loss in term of forgone marketable size (having the total cost = 100%), by species.

For small otter board trawl, the highest weight of by catches was crocker (0.63% of total catch) but due to lower price of marketable size, the economic loss was 11.23%of total fishing cost. School shrimp had the highest loss (40.16%) while the catch share was only 0.19%. In term of weight share, following crocker were sardinellas, school prawn, mantis shrimp, squid, cuttlefish, swimming crab, and trevallies in respective order. In term of loss following the school prawn were swimming crab, crocker, mantis shrimp, sardinellas, squid, cuttlefish, and trevallies in respective order.

For push net in the upper Gulf, the economic loss was as high as more than 8 times of the fishing cost. The highest loss was school prawn, followed by banana shrimp, swimming crab, trevallies, sadinellas and crocker. In term of percentage in total catch, the highest was school prawn (25.00%), followed by trevallies, sardinellas, crocker, swimming crab, and banana shrimp. In the lower Gulf the highest loss was squid and swimming crab while the highest weight were sardinellas, anchovy and swimming crab. The loss was only 19.84% of the total fishing cost, due to less resource abundance, in fishing ground as well as in time.

For anchovy purse seine in the eastern Gulf, the highest weight by catch was sardinellas (1.32%), followed by Indian mackerel, trevallies, and squid while in term of loss the highest was squid (8.33% from the total 10.82%) followed by sardinellas, Indian mackerel, and trevallies. The economic loss from anchovy light luring purse seine was higher being 25.55%. The highest loss was sardinellas (12.62%) and Indian mackerel (12.06%). In term of weight, by catches were 39.36% in total, mainly sardinellas (29.84%).

Accounting for economic loss due to forgone marketable size of juvenile economic species caught and sold as trash fish, fisheries in the Gulf of Thailand could not be profitable.

Table 3: Share of juvenile economic species in catch weight and economic loss as percentage of total cost

Species	% Weight in total catch	Loss as % of total fishing cost	Species	% Weight in total catch	Loss as % of total fishing cost
Small otter board trawl in the upper Gulf*1					
Crocker	0.63	11.27			
Sardinellas	0.30	9.28			
Trevallies	0.01	0.49			
Squid	0.09	2.10			
Cuttlefish	0.07	2.00			
Mantis shrimp	0.19	10.26			
School prawn	0.19	40.16			
Swimming crab	0.06	14.85			
TOTAL	**1.53**	**90.42**			
Push net in the upper Gulf*1			**Push net in lower Gulf*2**		
Crocker	10.41	11.46	Crocker	2.17	1.31
Sardinellas	15.05	28.93	Flatfish	0.08	0.02
Trevallies	16.94	91.82	Sand whiting	0.15	0.14
School prawn	25.00	324.29	Big eyes	0.02	0.01
Banana shrimp	1.38	201.42	Threadfin bream	0.82	0.87
Swimming crab	9.75	158.91	Lizard fish	0.75	0.17
TOTAL	**78.53**	**816.84**	Blacktip goat fish	0.05	0.01
			Anchovy	3.13	0.24
			Indo-Pacific mackerel	0.37	0.32
			Sardinellas	3.41	0.07
			Trevallies	1.49	0.42
			Squid	0.34	13.59
			Cuttlefish	1.38	-0.04
			Swimming crab	1.08	2.53
			TOTAL	**15.25**	**19.64**
Anchovy purse seine in the eastern Gulf*3			**Anchovy light luring in the eastern Gulf*3**		
Indian mackerel	0.32	0.77	Indian mackerel	8.76	12.06
Sardinellas	1.32	1.68	Sardinellas	29.84	12.62
Trevallies	0.21	0.04	Trevallies	0.27	0.08
Squid	0.07	8.33	Squid	0.49	0.79
TOTAL	**1.92**	**10.82**	**TOTAL**	**39.36**	**25.55**

Source: Calculated from *1 Suteemeechaikul (1992) *2 Dechboon (1998) and *3 Saikliang (1995).

COST AND RETURNS OF SELECTED GEARS IN 2004

In Table 4, cost and returns per day of small otter board trawler in the upper Gulf, push net in the upper Gulf and the lower Gulf were given. Small otter board trawler in the upper Gulf lost by Baht111/day. Main catch was trash fish (72.85%) including those juvenile economic species caught as trash fish. The major income earning, nonetheless was shrimp (82.21% of total cost).

For push net in the upper Gulf, the economic loss was as high as more than 8 times of the fishing cost. The highest loss was school prawn, followed by banana shrimp, swimming crab, trevallies, sadinellas and crocker. In term of percentage in total catch, the highest was school prawn (25.00%), followed by trevallies, sardinellas, crocker, swimming crab, and banana shrimp. In the lower Gulf the highest loss was squid and swimming crab while the highest weight were sardinellas, anchovy and swimming crab. The loss was only 19.84% of the total fishing cost, due to less resource abundance, in fishing ground as well as in time.

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Accounting for economic loss due to forgone marketable size of juvenile economic species caught and sold as trash fish, fisheries in the Gulf of Thailand could not be profitable.

Table 4 Cost and return per day of selected fishing vessels in 2004

Item	Small otter board trawler in upper Gulf			Push netter in upper Gulf			Push netter in lower Gulf		
	฿/ day	% of catches	%of TC	฿/ day	% of catches	%of TC	฿/ day	% of catches	%of TC
Total cost	**4,838**		**100.00**	**10,134**		**100.00**	**7,102**		**100.00**
fixed cost	127		2.61	235		2.32	235		3.31
variable cost	4,712		97.39	9,899		97.68	6867		96.69
Total revenue	**4,727**		**97.71**	**12,065**		**119.06**	**7,658**		**107.84**
trash fish	750	72.85	15.50	1,631	71.53	16.09	1,250	77.76	17.60
shrimp	3,977	27.15	82.21	7,185	13.93	70.90	3,667	10.78	51.63
sergistid	-		0.00	1,135	5.12	11.20	-	-	0.00
squid	-		0.00	979	7.30	9.66	700	4.12	9.86
others	-		0.00	1,135	2.12	11.20	2,042	7.34	28.75
Fishing profit	**(111)**		**-2.29**	**1,931**		**19.06**	**557**		**7.84**

Source: Calculated from Tokrisna et al (1 and 2)

Push netter in the upper Gulf was still profitable in 2004. The profit was 19.06% of total cost or Baht 1,931/day while 71.53% of the catches were trash fish. The main income earning was also from shrimp (70.90%).

For push netter in the lower Gulf, the profit was lower i.e. Baht557/day or 7.84% of the total fishing cost. 77.78% of the catch was trash fish with an income earning of only 17.60% of total cost. Shrimp earned only 51.63% of total cost. There were also earnings from squid and others including some food fish and other crustaceans.

CONCLUSION

Main fishing gears in the Gulf of Thailand including otter board trawl, push net, and anchovy purse seine had been using fine mesh size thus caught juvenile economic species and sold as trash fish at low price. If these juvenile economic species were allowed to grow to marketable size, they could generate better income for Thai fisheries. Lack of effectiveness in fishery management led to over fishing and thus fishery resource degradation, a higher fishing cost and lower income. The economic loss from lack of effective management and forgone value of economic species caught as trash fish should be accounted. Information on these losses could lead to a higher investment for effective regulation and management in Thai fisheries.

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ENDNOTES

[1] Panayotou and Jetanavanich, 1987, pp.51 – 57.